

COST PER FLYING HOUR ANALYSIS
OF THE C-141

THESIS

Christopher J. Omlor, Captain, USAF

AFIT/GTM/LAL/97S-7

19971008 060

Approved for public release; distribution unlimited.

[DMIC QUALITY INSPECTED 3]

The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

COST PER FLYING HOUR ANALYSIS
OF THE C-141

THESIS

Presented to the Faculty of the Graduate School of Logistics
and Acquisition Management of the
Air Force Institute of Technology
Air University
Air Education and Training Command
In Partial Fulfillment of the Requirements for the Degree of
Master of Science in Logistics Management

Christopher J. Omlor, B.S., M.B.A.
Captain, USAF

September 1997

Approved for public release; distribution unlimited.

Preface

First and foremost, I am indebted to my wife, Carla, and my daughters, Sara and Joya, who persevered the long hours alone while I worked throughout the development of this project. I can only hope in our future together that I can adequately repay them.

Second, I would like to express my appreciation to Dr. William Cunningham and Maj William Scott whose guidance and wisdom allowed this project to come to full fruition.

Finally, I would like to personally thank everyone who went above and beyond to provide data critical to the development of the figures and costs presented in this thesis.

Christopher J. Omlor

Table of Contents

	Page
Preface.....	ii
List of Figures.....	v
List of Tables.....	vi
Abstract.....	vii
I. Introduction.....	1
The Concern.....	1
Background.....	4
II. Literature Review.....	10
History and Mission of the C-141 Cargo Fleet.....	10
Why Maintain a USAF Cargo Fleet?.....	11
Transfer Pricing.....	13
AMC's Transfer Price.....	15
The Choice of Transfer Pricing Method.....	16
Data Limitations.....	23
III. Methodology	
The Current Costs Used For Pricing.....	26
Civilian Pay.....	26
Depot Maintenance and Repairable Assets.....	28
Aviation POL-Fly and Travel.....	33
Supplies and Equipment.....	35
Depreciation.....	37
General and Administrative.....	39
Other.....	42
IV. Analysis	
Adjusted Transfer Price.....	44
The Cost Problem.....	48
The Death Spiral.....	52
Sensitivity.....	54
V. Conclusion	
The Problem Statement Explored.....	57
The Death Spiral Revisited.....	58
The Long Range Perspective.....	60
Goal Accomplishment	61
When to Go Commercial.....	63
Future Work.....	63
Appendix A: List of Acronyms and Abbreviations.....	65

	Page
Bibliography.....	66
Vita.....	71

List of Figures

	Page
1. Transfer Price Comparison.....	51
2. The Death Spiral.....	53

List of Tables

	Page
1. Cost of Civilian Pay at Full and Variable Cost.....	28
2. Cost of Depot Maintenance at Full and Variable Cost.....	33
3. Cost of Depot Level Repairables at Full and Variable Cost.....	33
4. Cost of Fuel at Full and Variable Cost.....	34
5. Cost of Travel at Full and Variable Cost.....	34
6. Cost of Supplies and Equipment at Full and Variable Cost.....	37
7. Cost of Depreciation at Full and Variable Cost.....	39
8. Cost of General and Administrative at Full and Variable Cost.....	42
9. Cost of Other at Full and Variable Cost.....	43
10. Relevant Costs.....	47
11. Cost of C-141 Airlift Mission at Full Cost and at Variable Cost.....	50
12. Commercial Rate Calculation.....	51
13. Sensitivity to Assumptions.....	55

Abstract

This paper sought to examine if DoD's current transfer pricing method places AMC in a price competitive position with the government commercial rates and promotes managers to make the best decisions. Attention was paid to the stated customer concerns that current transfer pricing methods incorporate overhead and sunk costs that are not attributable to routine movement of peacetime cargo and could make AMC non-price competitive with commercial vendors.

The findings are that AMC currently uses full cost transfer pricing, as required by DoD policy, that includes significant overhead and sunk costs associated with its wartime responsibilities. The full cost method of transfer pricing is not in congruence with the generally accepted accounting practices and the private sector position that, with excess capacity and no outside market, a unit should transfer price at variable cost (Rayburn, 1986:977).

The current cost per flying hour is inflated by fixed costs, primarily overhead and sunk cost, by 60.47 percent. This means the CPFH is 2.5 times greater than the cost that AMC incurs for operating a peacetime mission.

COST PER FLYING HOUR ANALYSIS OF THE C-141

I. Introduction

The Concern

Assume for a minute that you are the air transportation manager for a large multinational firm. At your disposal is an aircraft fleet that is far in excess of daily flight needs and is owned outright (no debt) by your organization. In addition to this fleet, you have, free of charge, a pilot and crew for each plane. Yet despite these facts, you are losing business to your competition. Why is this happening when there are essentially free crews and planes? The reason is, your company will not let you sell your services to an outside market, yet your company will allow outside market firms to compete for its air freight movement business. This may seem far fetched, but it is the reality facing the United States Air Force's Air Mobility Command (AMC) today.

Privatization and outsourcing have become the latest movements within the Department of Defense (DoD) to attempt to work smarter and reduce budgetary expenditures. One of

the outsourcing trends has been to contract commercial carriers for government airlift. Federal Express currently has a contract to handle some of General Services Administration cargo movements (Sabo, 1997). More recently, HQ AMC/DON introduced a new program that will give 96.4 percent of all Defense Logistics Agency overseas priority shipments to commercial carriers, an estimated five percent of AMC channel mission revenues (Sabo, 1997).

The move toward savings via privatization and outsourcing could become an important factor when future decisions regarding the size of the AMC fleet are made. The current AMC fleet's capacity is four to five times the requirement for day to day peacetime operations (Gebman et al., 1996:22). Each time commercial carriers deliver military cargo, organic cargo capacity that has been purchased by DoD sits idle. As was witnessed for the C-17, the argument for maintaining readiness is cited to defend or seek funding for an organic air cargo fleet (Fulghum 1994:20). However, without a defined enemy or ongoing conflict to support and facing a time of severe budget restrictions, fleet funding for new aircraft and maintenance of existing assets appears to be a prime area for reduction particularly since DoD is already committed to using substantial commercial carrier support for wartime missions. DoD currently plans on having 40 percent of its wartime

airlift come from the Civil Reserve Air Fleet (Cunningham, 1997).

Clearly, the central issue is why AMC planes are not being tasked to perform the peacetime cargo missions. Some have argued for less flying hours to protect older assets like the C-141 from further peacetime wear and tear so that the planes can be preserved for their wartime role (Gebicke, 1994:12). This argument provides a technical reason, but this argument for C-141 is based heavily upon a failed retrofit that was intended to extend the life of the plane but actually reduced the life and carrying capacity of the C-141 (Bond 1990:21). Thus, this will not be a strong argument for the new C-17s nor does it establish why, if at all, customers might seek out commercial service over AMC service. In briefings presented by USAF Logistics, it is revealed that cost and service appear to be the two main customer concerns for AMC (Butler, 1996:8-9). Air Combat Command wants improved services and costs to be "...realistic and affordable,". The Defense Logistics Agency is asking for a more cost effective system with reduced overhead and elimination of readiness costs (Butler, 1996:8-9).

The answer to the customer's concern for improved service is clearly important, but it is a rather nebulous issue to analyze. On the other hand, the issue of DoD

pricing can be evaluated using standard accounting techniques. This analysis of AMC's current costs and their applicability to the price charged to the customer shall be the focus of this paper.

Background

In 1991, the General Accounting Office (GAO) testified before the congressional Subcommittee on Readiness, House Committee on Armed Services, that DoD and Congress were unaware of the total support cost for operating the military components, such as Air Force Wings (Kingsbury and Connor 1992; 3). Maj. Paul G. Hough (1993;14) identified weaknesses in the budget process, such as that cited by the GAO, and a need to "scope down" support forces in proportions to operating forces as DOD moved to the "base force", which was defined as the minimum force requirement necessary to provide defense, forced DoD to change accounting practices. According to Maj. Hough (1993;14), to correct the weaknesses and effect this reduced force in a logical fashion, DoD developed the Unit Cost Resourcing program to tie funding levels to outputs. As an outgrowth of the Unit Cost Resourcing program, in October 1991 the Defense Business Operating Fund (DBOF) was created with the goal of focusing management attention on the total cost of performing certain DOD activities (Bowsher 1994; 11). Under

this program, specific organizations, such as military depots, no longer received all of their funding directly from appropriations. Lower echelon units were given these funds, and, when an item or service was provided to them by a DBOF organization, the DBOF organization charged the unit for the work performed. Thus, AMC, as a DBOF organization, began charging customers for transportation services to support its DBOF fund. In 1997, the fund was renamed, the Transportation Working Capital Fund (Nettemeyer 1997:1).

In accounting circles, the charging of services or products provided by one unit of an organization to another unit of the organization is referred to as transfer pricing (Horngren et al., 1994:864). There are three generally recognized methods of determining a transfer price (Arnstein and Gilabert, 1980:189). Cost based transfer prices are based upon costs which may be the total cost, the variable cost, etc. Market based transfer prices are determined by the current market rates. Negotiated transfer price are established via negotiation between the company's subunits. Currently, AMC is utilizing cost based transfer pricing and market based transfer pricing with the transfer price being based on either the cost per flying hour (CPFH) of the aircraft or capped at the competitive rate (O'Mara 19 Nov 1996:1). Regarding which method to use: "Ideally, the

chosen method should lead each subunit manager to make optimal decisions for the organization as a whole" (Horngren et al., 1994:864).

Cost per flying hour (CPFH) computations have drawn attention for several years. Yet, there is no evidence that the transfer prices have been examined from the perspective of whether or not transfer prices are computed in the manner that would elicit the best decisions for DoD as a whole from subunit managers in DoD. A review of the files available from the key repository of published defense related materials, referred to as the Defense Technical Information Center (DTIC), revealed that the majority of work in this area has concentrated on the individual cost areas often with the intent of reducing the cost of that element. Schloz and Jones (1994) studied the depot level repairable item (DLR) costs while Wallace (1984) focused on the use of CPFH for estimating changes to peacetime spares requirements. Still others, such as Theresa Lewis (1995), have studied comparisons with commercial costs.

However, as identified by Robin Vaughn in "Analysis of the Air Force Cost Analysis Improvement Group Cost Per Flying Hour Process" (1996), CPFH calculations recently came to the forefront. On 30 November 95, the Supply Management Business Area (SMBA) General Officer Steering Group decided to push for a standard CPFH process. This push resulted in

Capt. Vaughn's study under the Air Force Logistics Management Agency (AFLMA). His exploratory analysis identified that bases, in response to the annual call by Air Staff, computed their individual flying hour cost statistics quite differently. The difference in reporting was caused by the lack of a standardized methodology for the bases to follow. Additionally, numerous items, ranging from inadequate computer interface for data transfer to expense items being ignored, plague the accuracy of the CPFH calculations.

While Vaughn's study identified several issues related to the costing process, one key item not covered in his work that directly impacts AMC cargo airframes is the issue of transfer pricing. Vaughn's study focused on the CPFH program that is used for budgeting and analysis of flying hour programs (Vaughn, 1996:1). The CPFH process studied by Vaughn only uses expense elements for depot level repairables, consumable supplies, and fuel. AMC's program for developing transfer prices has nine program elements (O'Mara 27 September 1996:2) which attempt, as required by DoD policy (Unit Cost, 1994:12), to capture the total cost of operations:

Civilian Pay
Depot Maintenance
Depot Level Repairables
Aviation POL-Fly
Supplies/Equipment

Travel
Depreciation
General & Administrative
Other

The one exception to the full cost transfer price is a nine percent cost reduction in price for Special Assignment Airlift Missions (SAAM) and Joint Chiefs of Staff (JCS) exercise missions (O'Mara, 27 September 1996:1).

To establish if DoD's current transfer pricing method places AMC in a price competitive position with the government commercial rates and promotes managers to make the best decisions, the evaluation shall proceed in four parts. In chapter two, literature regarding the current method and accepted accounting practices shall be reviewed, and data limitations shall be discussed. In chapter three, each cost element will be reviewed for its applicability to the CPFH based upon the findings from part one. In chapter four, if necessary, a revised CPFH shall be developed to reflect the outcomes of the second part's cost evaluations that differ from the current costing methodology. Finally, in chapter five, conclusions regarding the current process verse any proposed changes shall be made, and recommendations shall be provided for future research. Attention shall be paid to the stated customer concerns that current transfer pricing methods incorporate overhead and sunk costs that are not attributable to routine movement of peacetime cargo and will

make AMC non-price competitive with commercial vendors. Customer concerns are an important point since any customer is unlikely to use a system if the customer does not believe it is to his or her benefit.

To enable development of the transfer pricing subject within this study, the study shall focus on the costs associated with the C-141. The C-141 aircraft was chosen based upon its time in the inventory. This should make the C-141 system well understood, cost calculations standard, and numerous costs should already have been fully recovered reducing the complexity of the study problem. However, it is important to note that the methodology could be applied to other cargo fleet assets that have costs computed in the same manner.

II. Literature Review

History And Mission Of The C-141 Cargo Fleet

In March of 1961, it was announced that Lockheed-Georgia had won a design contest to produce the C-141A Starlifter (Jane's, 1963-1964:242). The manufacturing of the fleet occurred thirty years ago between 1966 and 1968 with some modifications to extend its service life and cargo carrying capability started in 1977. Unfortunately, the fleet has since then encountered problems with cracks in critical joints and is now being replaced by the C-17 (Bond 1990;21).

AMC's homepage (1996) lists the C-141's primary function as "Long-range troop and cargo airlift." with a mission of:

The Starlifter fulfills the vast spectrum of airlift requirements through its ability to airlift combat forces over long distances, inject those forces and their equipment either by airland or airdrop, re-supply employed forces, and extract the sick and wounded from the hostile area to advanced medical facilities.

The C-141 fleet operates from several installations in the United States to support its customers around the world.

Why Maintain A USAF Cargo Fleet?

The reasons behind DoD maintaining an organic cargo fleet may seem obvious, but these reasons are important to the determination of the costs to be used in transfer pricing. To understand the need for an organic cargo fleet, one must examine the procurement process of the asset during which the military justifies its purchases. In today's post cold war context, the justification used for the C-141's modern-day replacement, the C-17, will give a reasonable picture of the cargo fleet's current purpose.

The argument used in the procurement process for the C-17 made clear that the Air Force procured the C-141 asset based upon "military necessity" criteria. In anticipation of the need for more airlift, RAND produced a three volume study entitled Finding the Right Mix of Military and Civil Airlift-Issues and Implications (Gebman et al., 1994;50-51). The RAND study showed that an alternative option to the C-17, using a C-17 and 747-400F (referred to as the C-33) mixture, would be more cost effective with a savings of over 25 billion dollars in life-cycle costs. David Fulghum reports that Air Force analysts concurred this alternative option would have "overriding advantage [of] low cost," yet another official rejected the option saying: "...in terms of being a definitive airlift solution...that is not the

case, ". Fulghum admits that:

The requirements that emerge from the Pentagon's MRS/BURU (Mobility Requirements Study/Bottom Up Review) will then fuel the Air Force's own Strategic Airlift Force Mix Analysis (SAFMA), which will produce the service's recommendations for a transport aircraft mix. (1994:20)

As reported by John Turpak (1996:30), Fulghum's prognostication became reality, and MRS/BURU resulted in the purchase of the C-17s that are now in production. The C-17 only option won out over the chief competitor the C-33 because the C-33 could not perform military unique operations such as operating from austere or short runways, and could not carry military unique outsized cargo such as tanks and missiles.

Based upon the justification of military unique needs, the number of peacetime cargo missions flown is not a reason for airframe selection. The Air Force would still have to maintain its unique organic cargo fleet to meet the unique requirements of troop and equipment movement for the MRS/BURU scenario making the fleet an unavoidable cost. This is not too far from the case now. Based upon planning factor estimates, the cargo fleet has between four to five times the capacity required for daily operations (Gebman et al., 1996:22). Additional support is that DOD concurred with a 1994 RAND report presented to the Chairman, Subcommittee on Readiness, Committee on Armed Services,

House of Representatives that suggested reducing peacetime flying hours to protect wartime capability (Gebicke, 1994:12).

Transfer Pricing

In April 1994, Charles Bowsher, Comptroller General of the United States, testified before the U.S. Senate, in relation to DBOF "The Fund's primary purpose is to focus the attention of all levels of management on the total cost of carrying out certain critical DOD business operations." (1994:11) and goes on to say that DBOF is "...modeled after private sector business operations." In practice, Bowsher's private sector reference is to the business practice known as transfer pricing (Skousen et al., 1996:1173). The DoD literature sometimes uses the term "Unit Cost Pricing" for transfer pricing, but this thesis shall primarily utilize the generally accepted term transfer pricing.

There are several variations on the definition of transfer pricing, but an applicable one for AMC's situation is "Transfer pricing is the dollar basis used for transferring goods or services from one affiliated unit to another" (Cashin and Polimeni 1981:716). The service to be transferred is the use of the C-141 by an organization to move some commodity or passenger. The dollar basis is the

price charged by AMC for use of the service, and the affiliated units are the various branches of the federal government of the United States that use AMC aircraft.

Transfer pricing goals seem to be consistent with the stated objectives of Mr. Bowsher in that they seek to accomplish three things (Horngren et al., 1994:864):

1. Promote goal congruence. This is achieved when each subunit manager acting in his or her best interest automatically achieves the best case outcome for the organization.
2. Promote a sustained level of management effort where effort is defined as the exertion toward a goal.
3. Promote a high level of subunit autonomy in decision making. (This is particularly useful if a high degree of decentralization is favored by top management.)

Items one and two fall in line with the intent of DBOF's goal. Item three matches as well but for a less obvious reason. While DBOF did not make DoD decentralized, DoD is by fact decentralized with its bases around the world and commanders at each installation reacting to different conditions and national cultures.

There are three generally recognized methods of determining transfer prices (Arnstein and Gilabert, 1980:189):

1. Cost based transfer price. Under this scheme the transfer price is set at some cost. This could be

marginal cost, full product cost, variable cost, etc., and these costs could be actual or budgeted.

2. Market based transfer price. Decisions under this plan are based upon market prices determined by any method such as reading trade journal or determining competitors rates.

3. Negotiated transfer price. In this situation the subunits of a company establish via negotiation a price to be paid by the buyer.

In regards to which method is best, "Ideally, the chosen method should lead each subunit manager to make optimal decisions for the organization as a whole" (Horngren et al., 1994;864).

AMC's Transfer Price

According to HQ AMC/FMBT, AMC is utilizing cost based transfer pricing and market based transfer pricing:

The rates for the channel are capped to be competitive with the commercial sector. Over channels where there is no commercial competition, the computation is miles times a rate per pound or per passenger mile. The rate would be the same if a C-141, C-5, or C-17 operates a mission. Policy decisions that drive the current hourly rate structure are full cost recovery for training rates and 91 percent cost recovery for SAAM/JCS exercise missions. (O'Mara, 27 September 1996;1)

AMC rates, in accordance with DOD mandates (Unit Cost, 1994:12), must be established via full cost recovery and are derived from AMC's use of the nine cost categories previously outlined. These nine categories totaled over

6,337 dollars per flying hour for FY 97 (O'Mara, 26 September 1996:2).

The distribution of costs is spread over the five business areas of channel, SAAM, international air evacuation, JCS exercise, and training (O'Mara, 26 September 1996;1). The exact method of distribution is:

The method of cost allocation is flying hours. The flying hour worksheet provides hour in each of the five business areas. The formula to develop the cost for a business area is C-141 cost divided by total flying hours times flying hours in the business area equal cost for the business area. The formula for training rate is cost in the business area divided by training flying hours equals rate; SAAM/JCS exercise rate is cost in the business area times 91 percent divided by SAAM and JCS exercise flying hours equals rate. (O'Mara 19 Nov 96;1)

The Choice of Transfer Pricing Method

Before one can select a method of transfer pricing, one must establish the conditions under which a company is operating. AMC is operating in conditions that are not faced by its competitors. AMC is a military organization and operates on a nonprofit basis. Other carriers like Federal Express, DHL, Emeroy, etc. are for profit organizations. AMC cannot sell airlift to whomever it wishes. AMC may only provide service to government agencies. While this is not physical, constraint, this limit nonetheless prevents AMC from having an outside market for

its goods and services, yet AMC must compete with the commercial sector carriers for DOD's business. AMC, unlike its competitors, does not owe any money on its fleet. AMC has cargo carrying capacity far in excess of its day to day requirements (Gebman et al., 1996:22) because AMC's fleet was not purchased or sized, as shown above, for moving peacetime cargo.

Translating the preceding information into transfer pricing, let us first examine the concept of transfer pricing which is based upon a negotiated rate. The negotiated transfer prices should never be lower than the variable cost of the producing unit or higher than the full cost of production (Skousen et al., 1996;978). The negotiated transfer price method does have stipulations. Letricia Rayburn (1986;976) reports that this method is normally used "...in the absence of an outside competitive market." This limitation is a common theme and as it is put by Skousen, Albrecht, and Stice (1996;978):

Sometimes an outside market either does not exist or is not a viable alternative...In such cases, management may allow the parties involved to negotiate a transfer price rather than use a cost based approach.

The negotiated method's key assumption of no outside market is out of sync with the AMC situation. There is a well developed competitive market amongst air cargo carriers

for peacetime cargo that DoD itself uses to move cargo (Sabo, 1997). The fact that AMC cannot participate outside the DOD does not negate its effects. Therefore, based upon AMC's circumstances a negotiated rate would not seem to be a viable alternative and is, in fact, not currently used.

One can let the price be determined by the market and use a market based transfer price. The market based transfer price method finds some strong support. Skousen, Albrecht, and Stice write "Most managers agree, that where possible, a **market price** is probably the best transfer price to use." Market price works well because, according to the costing literature, it covers the opportunity costs, and it allows evaluation of units by profitability which is not necessarily applicable to DoD as DoD is not designed to make a profit.

The market price method also has some limits that make it inappropriate for all situations. As noted by Rayburn (1996;975), market price

...is used as a basis for transfer pricing when the product is actively traded on the open market....The use of the transfer price is especially appropriate when evaluating performance of segments since segment income is determined by how well the division functions in a competitive market...

Skousen et al. (1996;976), as well as Rayburn (1986;976), find this method also is of limited value if an item has no market price.

Returning to the AMC situation, there is a competitive market outside DOD for air cargo services. However, AMC, because of the limits referred to before, is not part of this competitive market. Additionally, AMC does haul some items such as tanks, missiles etc. that are too large for commercial carriers as well as traveling into hostile locations that may not have commercial service. AMC does use market pricing when it matches competitor's rates that are lower than its own: "The rates for the channel are capped to be competitive with the commercial sector" (O'Mara 19 Nov 96;1).

Establishing transfer price via one of the cost methods is the last method to consider. For the AMC situation, the transfer price to use under these circumstances is described by John Neuner and Edward Deakin III,

If for any reason the selling division is unable to sell excess production to the outside, then the out of pocket costs for the transfer would be equal to the costs needed to produce the additional units to be transferred plus any costs to ship the product to the buying division. Fixed costs will be unchanged, and can be ignored for this determination, and the opportunity costs would be zero. (1977;413)

Additional resources for similar arguments include:

Variable costs are most appropriate as the basis for transfer prices when no outside market exists but there is excess capacity. (Skousen et al., 1996;977)

Variable cost....This is an appropriate transfer price for guiding top management in deciding whether there should be transfers between the two divisions as long

as the total variable costs are less than the outside purchase price of the buying division. This transfer price would be appropriate only if the selling division had excess capacity. (Letricia Rayburn, 1986;977)

Based upon the variable cost transfer pricing's assumptions of excess capacity and lack of opportunity in outside markets match to the AMC situation, this method is the most suitable methodology for establishing an AMC cost based transfer price.

Variable cost is defied to be "Costs that change in total in direct proportion to changes in activity level" (Skousen 1996;1173). The second way of viewing the relevant costs is from the perspective of cost avoidance. The United States has not been involved in a major armed conflict since Vietnam, yet well over two million soldiers and billions of dollars in military hardware have been hired and procured to defend the nation. Putting the above information into the context of the C-141 issue, if C-141s never deliver peacetime cargo and are required and maintained to support a potential war, the costs of the C-141 fleet are unavoidable. The only C-141 costs that would be avoidable from the manager's perspective are those costs, above the sunk costs, incurred by operating the fleet to move peacetime cargo above and beyond readiness costs. Noting that the above references are well established standard accounting subject

matter texts, only one non-DoD text identified a deviation from this suggested methodology under these conditions.

The DoD articles emphasize that utilization of full costs helps managers control costs. The concept of using full costs for items is mandated by the Managerial Cost Accounting Concepts and Standards for the Federal Government, Statement of Federal Accounting Standards Number 4 (1995,2). The Unit Cost Handbook published by DoD (1994;5) emphasizes that focusing on total costs "...encourages a new and more meaningful understanding of production processes at all management levels. It also assists managers in determining more efficient uses of resources available to them." Charles LaCivita and Robert Pirog found "The application of unit cost principles offers the potential for significant cost savings..." (1991;24). Basso and Thomas (1991,16) reported that unit costing was "...our best opportunity to reduce the cost of doing business." Maj. Paul G. Hough (1993,20) concludes that "Unit cost resourcing holds great promise toward increasing the efficiency of DoD's support operations." Unfortunately, none of these works presented studies showing that full costing benefits DoD as a whole or that full cost transfer pricing accomplishes cost control nor was any such supporting study found in the literature reviewed. However,

Jerold Zimmerman (1997,208), found, that of the cost based transfer pricing methods used in corporations today, full cost transfer pricing dominated. He did conceded that full cost transfer pricing disagreed with theory and its use was driven by two major items not related to DoD's situation. First, the companies could buy and sell to the outside market making the full cost price a market based transfer price. Second, many of these companies were using full cost transfer prices to affect increased profitability by using legal loopholes to dodge expenses associated with taxes, duties, etc. that AMC does not face. Camm and Shulman of RAND found when working Air Force Stock Fund issues that this use of total costing will be most problematic in organizations that have excess capacity in peacetime. They state that wartime costs must be separated away from the routine costs to enable a decision maker to make the proper decisions for the organization as a whole (1993:12). In the next chapter, the process of cost segregation shall begin by defining the current cost recovery categories and values and then move on to a detailed examination of the appropriateness of each.

Data Limitations

It is critical, at this point in the discussions, that the potential limitations on the cost data be recognized because as noted by Lambert and Stock in their work *Strategic Logistics Management*:

Accurate cost data are required for successful implementation of the integrated logistics management ...They are also required for the management control of logistics operations. (1993:584)

Unfortunately, obtaining accurate financial information in DoD is a severe problem. In the same report that the Comptroller General of the United States says DBOF is being used to "...focus the attention of all levels of management on the total costs of carrying out certain critical DoD business operations." he concedes

...financial reports were inaccurate; and the cost accounting systems were fragmented...and did not provide the cost information necessary for manager to better control costs. (Bowsher, 1994:12)

Such concerns are shared by Frank Conahan, Senior Defense and Internal Advisor to the Comptroller General of the United States who reports in testimony before the House Committee on the Budget that upon presentation of the fiscal year 1995 budget The Secretary of Defense said: "(O)ur financial management...is a mess, and it is costing us money we desperately need" (Conahan, 1995:8). Mr. Conahan concurs

with this statement and goes on to call DOD's financial management "...a high risk area" (1995:8).

Mr. Conahan also goes on in the report to identify the source of the problem:

...ineffective management systems have impeded DOD's efforts to reduce the cost of operations. The Defense Business Operating Fund provides a mechanism through which DOD can adopt a business-like approach for identifying and reducing its operating costs. However, to date DOD has not achieved this objective. As discussed in our March 1995 report, DOD's ability to properly manage funds continues to be hindered because of DOD's inability to (1) manage cash, (2) enhance financial systems, and (3) produce accurate financial reports on the results of operations. Systems that produce credible cost data are essential for the successful operation of the fund. Accurate cost data are also critical to developing systematic means of reducing the cost of operations.

Until DOD's antiquated financial systems are fixed, the infrastructure cost of maintaining multiple systems for the same purpose will continue, and decision makers will continue to receive inaccurate and unreliable information...

The first attempt at a comprehensive study of the CPFH program ran into this stumbling block. Robin Vaughn (1996;9) reports that wing level agencies were using a different set of computerized information tracking systems to manage supplies and flying hours than their headquarters' level staffs. In both cases, he found the interfaces between the two systems were failing to properly update each

other and recommended better interfaces be established.

While Vaughn's study affects only these two areas of contention, without an in-depth analysis of each reporting system in the costing process, validation of the figures is impossible. However, the AMC cost figures are being used by managers to make decisions; therefore, the figures utilized shall be those provided by HQ AMC/FMBT and shall be accepted as accurate.

III. Methodology

The Current Costs Used For Pricing

With variable cost transfer pricing as the method most applicable to AMC's current situation for the C-141, it is time to examine the costs that are currently included. From this examination, all current costs that are part of the price can be identified and reviewed for their applicability to the transfer price at variable cost.

AMC provides the C-141 costs in terms of nine cost areas (O'Mara, 1996:2). The nine cost areas and their FY 1997 values are as follows (on a per flying hour basis):

Civilian Pay	\$238
Depot Maintenance	\$1,259
Depot Level Repairables	\$738
Aviation POL-Fly	\$1,648
Supplies/Equipment	\$361
Travel	\$217
Depreciation	\$346
General & Administrative	\$996
Other	\$534
Total	\$6,337

Since no indicator identifying whether these costs are fixed or variable is provided, each area is examined below to determine if it is an applicable variable cost.

Civilian Pay

A quick glance at the nine cost categories listed above reveals that military and civilian pay are not handled

in the same manner by the current methodology. There is a cost element for civilian pay but not for military pay. From a cost perspective, not charging for military pay is equivalent to American Airlines getting its all or part of its pilots, crews, ground crews, etc. for free. Free crews obviously has the potential to equate to a significant cost advantage.

From a cost avoidance perspective, the planes and pilots are there to support MRS/BURU conclusions making both unavoidable costs and the non-inclusion of the crews costs is logical. However, this concept must be extended even further. If the United States went to war tomorrow, would these civilians disappear? If the answer is yes, then the civilian personnel are an avoidable cost strictly associated with peacetime business. If the answer is no, the civilians are a sunk cost associated with maintaining a war ready repair facility. No reference in any database to include DTIC was found that suggested these personnel would be fired in the event of war. Therefore, they are not a variable cost associated with peacetime cargo movement. One exception to this is, that should overtime be incurred for the movement of peacetime cargo, it would be a chargeable cost as this overtime represents a cost above the normal pay requirements needed to retain the employee's services.

Summarizing the above items in Table 1:

Table 1

Cost of Civilian Pay at Full and Variable Cost

Cost of Civilian Pay at:	Percentage of Original Value	Cost in Dollars Per Hour
Full Cost	100	238.00
Variable Cost	0	0.00
Reduction	100	238.00

Depot Maintenance and Repairable Assets

HQ AFMC/ FMRI tracks composite figures for depot work on C-141 assets (This unit maintains composite figures by airframe and an overall composite figure.) The composite figures are provided to them by the depots and reflects the sum of the costs in each category divided by the total number of available hours which gives a per hour cost figure. The composite figures below represents the 1997 sales rates (prices) for all items maintenance and repairables work for the C-141 (Cambell and Woller 1997):

Direct Labor	\$25.07 per hour
Direct Materials	\$16.82 per hour
Production Overhead	\$26.77 per hour
<u>General and Administrative Overhead</u>	<u>\$8.20 per hour</u>
Total Cost	\$76.86 per hour

The figures show that \$34.97 (Production Overhead plus General and Administrative Overhead) of \$76.86 per hour

costs, or 45.5 percent of depot costs, is overhead.

Additionally, direct labor accounts for an additional 32.6 percent of the cost.

Depot maintenance and repairable assets would seem to be a purely variable function of the number of hours flown, but they are not. Two separate Air Force Institute of Technology (AFIT) studies on depot maintenance costs found that these costs are not all a function of flying hours.

The first thesis, by Captain Michael Waker, found

...the driving force for repair is not usage related but totally time related. Costs that are captured in this category are those of an overhaul kind...items that are marked rebuild or replace on a fixed time interval are examples of the type of costs captured in this category. (1987;49)

The second AFIT thesis, by Captain Patricia Larsen, applied to the Air Force cargo fleets and found that only 75 percent of depot maintenance costs which included "...repair, modification, alterations,..., or rebuilding of parts, assemblies, subassemblies, components, equipment end items and weapon systems..."(1986;99) "...were traceable to flying hours" (1986;xi and 99). For the depot overhaul costs, excluding engine overhaul for which she could not establish any relationship, were examined, this ratio drops to 35 percent (1986,xii).

Larsen suspected that the lack of ability to develop any measure for engine overhauls was related to the fact

that engines were scheduled based upon operating hours not flying hours (1986:62). From the AMC provided data, the AMC Depot Maintenance category matches the overhaul situation described by Larsen (O'Mara 19 Nov 1996, 2): "Depot Procured Engine Maintenance is not computed by any type of flying hour factors. DPEM for engines and airframes is based upon other factors."

Some of the reason for the cost not varying directly with flying hours can be explained by overhead at the depots. As seen above, overhead reflects 45.5 percent of the cost per hour for repairs at the depot. Depots have cost allocation issues that put them in a similar position to AMC. Both exist to service the military and cannot compete in a free and open market as the depots. The depots have excess maintenance capacity as is reported in the GAO report Closing Maintenance Depots (1996:14).

Unlike the model of transfer pricing at variable cost when there is no outside market and excess capacity is available, the depots are using full cost transfer pricing (Unit Cost, 1994:10). The depots also include expense elements that AMC does not such as military pay (GAO Defense Business Operating Fund 1994:6). Therefore, the depot costs must be evaluated based upon the fact that the overhead not associated with the repair itself is an unavoidable cost that should not be charged to the peacetime customer. This

view is supported by a RAND report on transfer pricing issues that found:

So long as indirect costs are allocated to the prices of services arbitrarily, truly fixed costs grossly distort prices;...an internal transfer pricing system cannot support local decisions that are consistent with DOD's Broader Goals (Camm and Shulmann, 1993:xiii). Therefore, overhead costs, 45.5 percent of the total costs must be removed from the cost figures for both Depot Maintenance and Repairables. This leaves 54.5 percent of the costs in these categories.

However, in the case of overhauls, Larsen's figures shows that only 35 percent of costs are related to flying hours. To explain this difference, the nature of the AMC's Depot Maintenance figure must be considered (O'Mara 19 Nov 1996, 2): "Depot Procured Engine Maintenance is not computed by any type of flying hour factors. DPEM for engines and airframes is based upon other factors." The other factor is a time period. For example, the C-141s rotate through a standard preprogrammed periodic depot maintenance cycle of 60 months (5 years) in accordance with TO 00-25-4 (O'Mara 1996;2). Unlike repairable assets that are sent into the depot immediately upon failure, this preprogrammed maintenance cycle, based upon time period not upon flying hours, gives extended stability in the workload making labor a fixed cost. If one adds the 32.6 percent of the cost

driven by direct labor to the overhead figure, the total figure for cost not varying with flying hours is 78.1 percent. The reduction leaves only 21.9 percent of costs, those associated with direct materials, as varying with flying hours.

From the above figures, the costs that are varying with the number of flying hours are 54.5 percent for repairables and 21.9 percent for Depot Maintenance. These figure are lower than the 75 and 35 percent proposed by Larsen's model. However, Larsen's figures were computed in the 1986 time frame prior to DBOF implementation. DBOF includes overhead costs such as depreciation (which will be addressed later in this paper) that were not included in costs considered by the accounting systems Larsen studied (1986;103-104). This can produce a significant impact. For example, in the AMC transfer price, depreciation alone is 5.6 percent, 346 dollars of 6337 dollars, of the transfer price. Additionally, in the case of engine overhauls, Larsen did not establish any relationship and thus ignored its impacts on the cost figures (1986;xii).

Summarizing the above cost reductions in Tables 2 and 3:

Table 2

Cost of Depot Maintenance at Full and Variable Cost

Cost of Depot Maintenance at:	Percentage of Original Value	Cost in Dollars Per Hour
Full Cost	100	1,259.00
Variable Cost	21.9	275.72
Reduction	78.1	983.28

Table 3

Cost of Depot Level Repairables at Full and Variable Cost

Cost of Depot Level Repairables at:	Percentage of Original Value	Cost in Dollars Per Hour
Full Cost	100	738.00
Variable Cost	54.5	402.21
Reduction	45.5	576.38

Aviation POL-Fly and Travel

The areas of fuel and travel are the most obvious area of agreement from a variable cost point of view. If one drives a car from point A to point B, the amount of fuel consumed is directly proportional to how far the car has been driven. For flights dedicated to peacetime cargo movement, fuel costs would be purely variable. By the same token, the more flights one has the more travel expenses the

crew will incur for per-diem, lodging, and possibly rental vehicles.

There is a caveat in this area. If hours are flown that are not producing peacetime routine cargo movement and serve some purpose other than benefiting the movement of this cargo, these fuel costs and travel costs must be subtracted from the total passed on to the customer. This issue arose in the area of training.

Tables 4 and 5 summarize the changes to the transfer prices for fuel and travel:

Table 4

Cost of Fuel at Full and Variable Cost

Cost of Fuel at:	Percentage of Original Value	Cost in Dollars Per Hour
Full Cost	100	1,648.00
Variable Cost	100	1,648.00
Reduction	0	1,648.00

Table 5

Cost of Travel at Full and Variable Cost

Cost of Travel at:	Percentage of Original Value	Cost in Dollars Per Hour
Full Cost	100	217.00
Variable Cost	100	217.00
Reduction	0	217.00

Training while not listed as one of the nine elements has a hidden role with costs tied to it. Training accounts

for 30,281 of 114,771 (26.3 percent) of total flying hours for the C-141 (O'Mara, 1996a:2). Air Force officials provided RAND an estimate that 25 percent of active duty and Reserve Associate training hours have no transportation value (Palmer et al., 1992:61). This means that all cost items tied to this 25 percent of training hours to include fuels, maintenance, etc. need to be subtracted from cost figures. These hours represent a sunk cost because the Air Force executes these missions to retain pilot proficiency. Note that this reduction is a conservative estimate as it could be argued that all training hour expenses including the maintenance, fuel, and travel expenses are an unavoidable cost. This reduction shall be done one time for the final cost figure in Chapter 4.

Supplies and Equipment

In this category are the items required for the day-to-day operations of the units. Since no record exists showing that AMC has ever stopped flying a C-141 unit for a whole year to see what costs are fixed then the best that can be done is to use existing methods and expert opinion. C-141 units were contacted to determine which costs varied in direct proportion to the flying hours (Full reference not provided at the request of sources.) The cost categories identified by HQ AMC/FMBT as in this category and their

percentage contribution to it (based on FY97 figures) are listed by their Element of Expense/Investment Codes (EEICs):

60X (605/609)	2.34%
605/609 Supplies (Stock Fund)	25.52%
61X Supplies (non stock fund)	33.57%
62X Equipment (stock fund)	17.27%
63X Equipment (non stock fund)	13.4%
641 MOGAS/Diesel	5.71%
693 Nonfly AVPOL	2.19%

The budget managers' opinions were that 693 and 61X would not vary with the number of hours flown, and 62X and 63X categories might vary to some slight degree but could not provide any estimate. However, 641 and 605/609 would change significantly with the number of flying hours.

The opinions provided agreed with the current CPFH computations. Vaughn's study (1996;9) found the CPFH computations of the program he studied used EEICs 605, 609, 644 (which covers repairables that have already been discussed above), and 699 (which covers POL and has already been addressed above). The same EEICs (605, 609, 644, and 699) included in the program studied by Vaughn were used by Capt. Gary Wiley and Master Sergeant Thaddus Dick in their article "Cost-Per-Flying-Hour Program: A Foundation For Wing Cost Reduction." Based upon the opinions of the budget manager EEIC 641 will be included and based upon existing existing methodology, EEICs 605 and 609 included in the variable cost figure for a total remaining percentage of 33.57 of the original value. EEICs 644 and 699 for

repaiables and POL-Fly have been addressed previously and will be included in the cost figures as stated in those sections. Review Table 6 below for a complete summary:

Table 6

Cost of Supplies and Equipment at Full and Variable Cost

Cost of Supplies and Equipment at:	Percentage of Original Value	Cost in Dollars Per Hour
Full Cost	100	361.00
Variable Cost	33.57	121.19
Reduction	66.43	239.81

Depreciation

The system currently tracks depreciation in the following categories (O'Mara, 1997:A-2),

- 51A Non-ADPE Equipment (FY1996, \$823K)
- 51B Minor Construction (FY1996, \$1,336K)
- 51D ADPE Equipment (FY1996, \$28,772K)
- 51E Software Development (FY1996, \$16,163)

The depreciation is determined

...by taking the amount of a capitalized asset less its estimated residual value and then divide (sic) equally among accounting periods during the assets useful life.

The depreciation tracking system does not break down by end item nor does the Air Force have any mechanized means of tracking this information. In order to come to a number for depreciation, a baseline figure developed in the FY93-94

time frame is used and adjusted each year via multiplication by an inflation factor provided by Transportation Command (O'Mara, 1997:A-2).

The GAO has already examined depreciation and reported in "The Role of Depreciation in Budgeting for Certain Federal Investments" that accounting experts agreed that depreciation was not "...well suited to a cash and obligation-based budget like that of the United States" (Posner, 1996:16-17). The GAO report also stated depreciation was used primarily by businesses to match revenues and expense and for tax reasons that do not apply to federal agencies except those setting user fees. (Note: user fees are not transfer prices.) The report goes on to say

Depreciation of assets in federal accounting is often not done because it is difficult to do and often provides little relevant information...depreciation of tangible assets is an imperfect way of spreading costs over the asset's useful life.

The General Accounting Office conclusion makes sense in the AMC situation. First, AMC did not buy its aircraft. Most are familiar with the fact that all major procurement is done as legislation which means that Congress funds the program, and it is paid for up front. AMC gets an asset "free and clear" if you will. AMC does not pay taxes as it is a part of the federal government, and AMC pays for other

budget items by cash allocated either in a procurement program or in a budget to the Air Force that must be spent within the fiscal year with residual funds pulled back from the Air Force. This issue brings up a very interesting secondary point worthy of study but beyond the scope of this thesis. If DBOF type funds are billing customers for depreciation and the assets were paid for by cash up front with no account for future purchases, what expenses are actually being covered by the depreciation funds?

Table 7 summarizes the effect on the transfer price:

Table 7
Cost of Depreciation at Full and Variable Cost

Cost of Depreciation at:	Percentage of Original Value	Cost in Dollars Per Hour
Full Cost	100	361.00
Variable Cost	0	0.00
Reduction	100	346.00

General and Administrative

AMC is required to reimburse providers of General and Administrative (G&A) support to "...Increase Cost Visibility" (Netemeyer, 1 Jan 97;attch 1). There are three key G&A accounts:

1. AMC G&A = DBOF-T ratio X base G&A funding

For units where AMC is the primary mission (Charleston, McCord, and Dover) DBOF-T is:

(base population - tenant population)/base
population

For units where AMC is a dual mission (Scott AFB and Travis AFB) DBOF-T is:

DBOF-T population/base population

For AMC headquarters DBOF-T is:

Command DBOF-T/command population

The base G&A elements consist of:

41856F Environmental Compliance
41876F Minor Construction
41878F Maintenance and Repair
41879F Real Property and Services
41890F Visual Information Activities
41895F Command and Base Communications
41896F Base Operations
48719F Child Development
48720F Family Support

2. HQ USTANSCOM G&A = HQ USTRANSCOM operating costs X
AMC's Percent of the entire USTRANSCOM Operating Budget
(Historically, AMC's share has been 61 to 65 percent,
and USTRANSCOM dictates this requirement to AMC.)

3. DFAS G&A = Rate X workload

The output elements are:

Civilian Accounts Maintained
Travel Vouchers Paid
Commercial Invoices Paid
Trial Balances Maintained

The General and Administrative category of costs is easily dealt with using DoD's Unit Cost Handbook. This reference under the General and Administrative Costs discussion (1994:12), specifically cites:

General and administrative (G&A) costs are those that cannot be reasonably associated with any particular product or service produced...Examples of G&A costs include functions such as local comptroller, security, facilities engineering, fire protection, custodial services, snow removal and similar types of base support functions.

This definition clearly places the G&A segment into the overhead category. Yet, there are two points to consider.

The first is that AMC is paying for overhead services at a rate dictated to them by USTRANSCOM. This concern specifically impacts AMC prices as cited in 1996 GAO report stating:

Defense transportation costs are substantially higher than necessary. DoD customers are frequently paying prices for transportation services that are double or triple the cost of the basic transportation...Key factors driving these higher costs are USTRANSCOM's fragmented and inefficient organizational structure and management processes, and the need to maintain a mobilization capability. (Hinton 1996:3)

The second point is the one possible exception to the exclusion of all G&A expenses. The DFSA G&A area includes a

comptroller that is not a local comptroller as would be excluded by the previous definition. Therefore AMCs travel vouchers and the commercial vouchers paid will vary with the number of flying hours as each is billed independently. This is logical as a mission will result in a voucher filing by each crew member and, planes landing at commercial fields or using any form of contract service will cause a voucher to be paid. Therefore, to be conservative these two items cost which represent 1.8% of the G&A figure shall be retained in the transfer price figure. See Table 8 below:

Table 8

Cost of General and Administrative at Full and Variable Cost

Cost of General and Administrative at:	Percentage of Original Value	Cost in Dollars Per Hour
Full Cost	100	996.00
Variable Cost	1.8	17.93
Reduction	100	978.07

Other

The final category to analyze is the category that is called "Other". This category is composed of a wide variety of commodities (O'Mara, 19 Nov 96) that include ADPE (\$169/hr.), facility maintenance and repair (\$158/hour), and utilities (\$169/hr.). These figures are developed based upon historical data from the bases and by "racking and

stacking" AMC requirements to set priorities. In the case of utilities the bases provide information on rate/price increases." A review of the G&A expenses shows they cover many of these same categories such as ADPE and facilities that the Unit Cost Handbook states are overhead and do not vary directly with flying hours (1994;12). Additionally, support is that these levels are "...held in "check" with historical levels. "In the CE and ADPE areas, the requirements will always exceed available funding. Commodity funding is normally kept in line with historical expense levels" (O'Mara 19 Nov 97, 8). Variable costs must vary directly with the number of hours flown, and if the need was truly greater than funding, flying hours would be cut. Therefore, the expenses of this category shall not be included in the transfer price. See summary Table 9.

Table 9
Cost of Other at Full and Variable Cost

Cost of Other at:	Percentage of Original Value	Cost in Dollars Per Hour
Full Cost	100	534.00
Variable Cost	1.8	0.00
Reduction	100	534.00

IV. Analysis

Adjusted Transfer Price

For review, the last chapter's evaluation of costs currently in the transfer price for AMC will be divided into three categories. In the first category are those costs that variable and unavoidable that will be entered in their entirety into the adjusted price. The second category includes the costs that are pure overhead and will be totally excluded from the computations of the price. The final category shall include those costs that include variable and fixed elements. For this third category, an adjustment factor shall be defined to reflect the percentage of costs within the figure that are variable.

Before beginning the category analysis, the training issue must be addressed. Training produced missions carrying no cargo but added to costs that were transfer to the customer. Specifically, 25 percent of all training results in missions that did not contribute to cargo movement (Palmer et al., 1992:61). Training hours represent 30,218 hours of the total 114,771 programmed hours for the C-141. As 25 percent of 30,218 hours is 7554.5, there are 6.6 percent of all hours flown that do not contribute to cargo movement. Therefore, 6.6 percent of all costs shall

be eliminated to compensate for this sunk cost. (Remember, this figure is a conservative estimate. As noted before, it can be argued that all training is a sunk cost, as training will occur even if no cargo moves via AMC missions.)

For the first category, variable costs, only two items were included. Fuel for the aircraft is considered to be purely variable and will be included in its entirety. Travel expenses will for a conservative estimate be assumed to represent travel expenditures associated with C-141 cargo movements.

For the second cost category, the items not relevant to variable cost, several items are included. Depreciation has no value in computing the variable costs and will be excluded. All G&A expenses are by DoD's definition not relevant to variable cost of an item (Unit Cost, 1994;12) and shall be excluded with the exception of the 1.8 percent associated with travel and commercial voucher processing. Along the same lines, the cost category of Other is composed of G&A type expenses and shall also be eliminated. The last item, Civilian Pay, like its military counterpart, is a sunk cost and as such shall be excluded.

The final category of costs, those that include a significant variable and fixed component, are the most

complex. Depot maintenance requires a reduction of 78.1 percent to adjust for fixed costs associated with overhead and direct labor. Repairables will require a reduction of 54.5 percent to account for the overhead of the depot. In the last category to be considered, Supplies and Equipment, costs covered by EEICs 605, 609 and 641 shall be entered into the figure directly and represent 33.57 percent of the original figure. All other EEICs shall be excluded. This figure reflects current practice and, in the case of EEIC 641, budget managers opinions.

The results of these cost decisions are summarized below:

Table 10

Relevant Costs

Category	Current Cost (1)	Adjustment Factor For Training	Adjustment Factor	Relevant Variable Cost (1) X (2)
Civilian Pay	\$238	.934	0	\$0.00
Depot Maintenance	\$1,259	.934	.219	\$257.52
Depot Level Repairables	\$738	.934	.545	\$375.66
Aviation POL-Fly	\$1,648	.934	1	\$1539.23
Supplies and Equipment	\$361	.934	.3357	\$113.19
Travel	\$217	.934	1	\$202.68
Depreciation	\$346	.934	0	\$0.00
General and Administrative	\$996	.934	.018	\$16.74
Other	\$534	.934	0	\$0.00
Total Cost	\$6,337			\$2,505.02

The results shown are quite startling but in line with other estimates. The variable cost price represents a reduction of 60.47 percent over the full cost price. Other research at AFIT found that for the KC-137 fixed costs represented 57 percent of the total cost figure (Bonasser, 1997). Additionally, this figure is in line with the GAO's report that DoD customers frequently pay double and even triple the basic cost of transportation (Hinton, 1996:3).

The Cost Problem

This calculation has very serious implications for the customer. Using the US Government Airlift Rates and Non-US Government Airlift Rates a direct comparison can be drawn. The comparison shall be done using Special Assignment Airlift Missions rates as the channel rates may be capped at competitive rates and thus not represent the AMC cost for the route (O'Mara, 1996:1). Since the data presented were for FY97 and wishing to demonstrate the problem full cost pricing can cause, the rate table that was published on 11 August 1995 will be used. The 1997 data should at the very least have been adjusted upward for inflation each of the last two years. This means that if the 1997 adjusted figure is lower than the 1995 rate and has impacted decisions, AMC has had, at variable cost, an unknown cost advantage for at least two years.

For organic airlift mission, the calculations based upon the formulas provided in the US Government Airlift Rates and Non-US Government Airlift Rates (O'Mara, 1995:A2-6). For our hypothetical example, a SAAM mission shall be required at McGuire AFB in New Jersey. This mission shall be assumed to fly 4000 miles and require no positioning charges as C-141s are available at McGuire AFB, and the commercial airport is immediately adjacent to the base. No other

charges or delays shall be incurred for this flight. See Table 11 on the next page.

Organic rate calculation: (Note: that this estimate is low as it uses the published C-141 rate as of 11 Aug 1995 which is below the rate given for FY 97.)

Table 11
 Cost of C-141 Airlift Mission at Full Cost and
 at Variable Cost

Category	Full Cost Method	Variable Cost Method
Miles	4000	4000
C-141 Air Speed	390	390
Flying Hours (Miles/Air Speed)	10.25	10.25
Depositioning hours	10.25	10.25
Total Flying Hours (Flying hours + Despositioning Hours)	20.5	20.5
Cost Per flying Hour	\$4,813	\$2,505.02
Cost Before Discount (Cost Per Hour X Total Hours)	\$98,666.50	\$51,352.91
10 Percent Discount (.1 X Cost Before Discount)	\$9,866.65	none
Total Cost	\$88,799.85	\$51,352.91

For the commercial rate calculation we find:

Table 12
Commercial Rate Calculation

Category	Value
Miles	4000
ACL	36.5
Cargo-Per Ton Mile	\$0.5101
Cost Before Discount (Miles X ACL X Cargo-Per Ton Mile)	\$74,474.60
-10% Discount	\$7,447.46
Cost of Commercial Mission	\$67,027.14

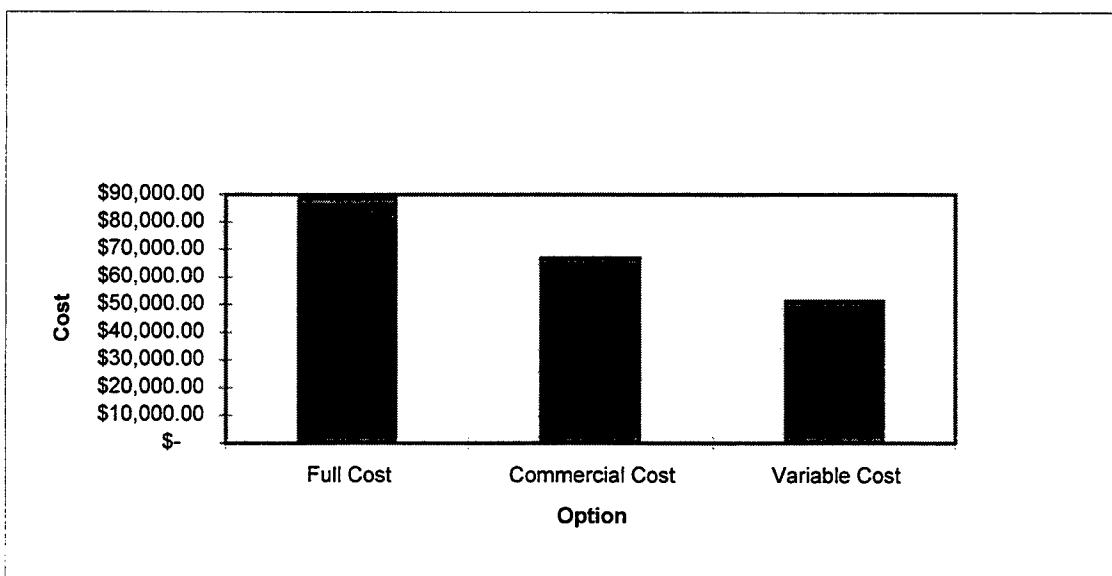


Figure 1: Transfer Price Comparison

This mission at full cost would have been over \$20,000 cheaper to perform via commercial aircraft. At variable cost, the mission is over \$15,000 cheaper to use organic lift. Note there is no discount at variable cost as it represents the true variable cost of operating the aircraft, and the discount proves to be unneeded from the most important perspective: price. This 1997 variable cost transfer price could be increased to as much as \$3,309.98 per hour, over a 32 percent increase, and still come out below the 1995 cost of the commercial carrier.

Had the decision been made based upon full cost recovery the customer would have paid an additional \$15,000, and the bid would have gone to a commercial carrier instead of contributing to AMC's revenue. The decision by the transportation manager would not have been in the best interest of the manager's unit or AMC.

The Death Spiral

While the impact of this new price is startling, the impact of not reducing the price and potentially losing business is even greater. For a complete understanding of this, assume that AMC's revenue continues to erode slowly via programs such as the new World Wide Express contract.

Assume also that no major reduction occur in missions or overhead, and thus, the fixed costs will remain the same and only the variable costs will change. As before, those items that varied directly with hours flown shall be reduced by the percent reduction in hours. All other costs shall remain at the same level. These cost will then be divided by the estimated needed hours. This will then establish the new cost per flying hour at full cost. See Figure 2 below.

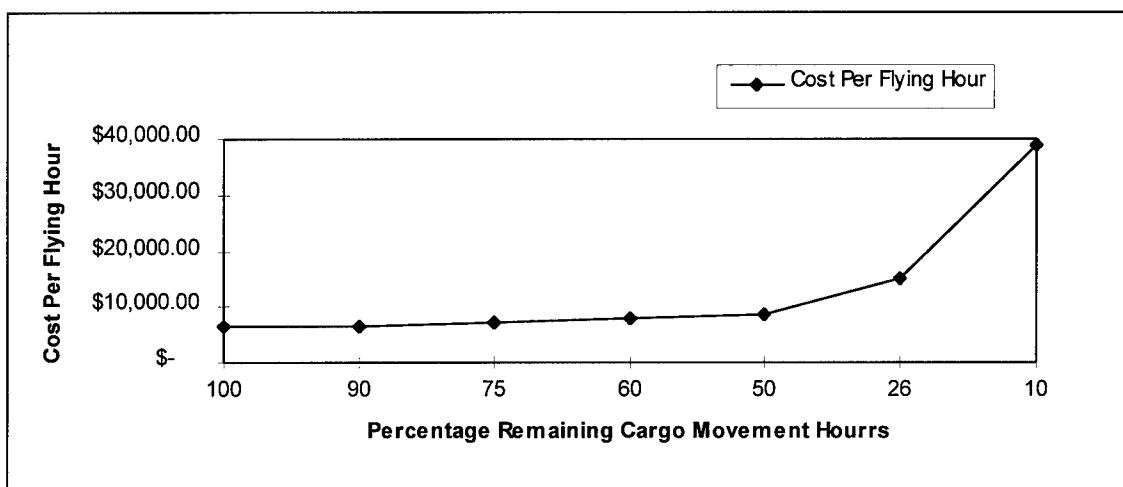


Figure 2. The Death Spiral

The implications of this simple calculation shown in the graphic above are a death spiral for AMC. As AMC's flying hours drop due to contracting out of airlift to commercial services, its overhead will continue to drive the total cost transfer price upward because there will be fewer hours over which to distribute the overhead costs. As noted

before, RAND stated overhead costs could severely distort the transfer prices (Camm and Shulman, 1993:xiii). The real explosion in costs would occur if cargo movement requirements are ever reduced below training hour needs seen on the graph at the 26 percent mark. After this point, all the costs of training hours would still be incurred but could only be distributed over the few remaining billable hours.

Sensitivity

For the earlier example of the 1997 variable rate verses the 1995 fixed rate and commercial rate, it was established that the value for the variable cost transfer price could reach as high as 3,309.98 dollars and still beat the 1995 commercial rate. However, there can be some argument that it did not establish a range within which the variable cost may lie. The variable cost established was based on several assumptions when if altered the variable cost may change. The two potentially most impacting assumptions were that not all training hours were a sunk cost and that direct labor for depot overhauls was a sunk cost. In Table 13 below, the assumptions will be modified individually as indicated in the table to establish a possible range of values for the variable CPFH. All other

assumptions not listed shall remain the same as stated in the paper.

Table 13

Sensitivity to Assumptions

Assumption Change	Resulting Cost Per Flying Hour
If all training hours are a sunk cost:	\$1,976.68
If direct labor for overhauls were variable:	\$2,933.65
If direct labor for overhauls and all Civilian Labor were variable:	\$3171.65

From the table it is clear that the variable cost figure of 2,505.02 dollars is not dramatically affected by several major assumptions. Even if the direct labor for the depot overhauls is factored back in the figure only rises 428.63 dollars to 2,933.65 dollars which is still a over a 53 percent reduction in the AMC rate due to elimination of fixed costs. In the most extreme case with all civilian labor at AMC and the depot variable, the figure only rises

to 3171.65 dollars which is still a 49.95 percent reduction in price due to fixed costs. Even at the 3171.65 dollar level, for the earlier example, the variable price cost would still have been the choice as it is below the 3,309.98 dollar threshold established as the variable price cutoff.

V. Conclusion

The Problem Statement Explored

This paper sought to examine if DoD's current transfer pricing method places AMC in a price competitive position with the government commercial rates and promotes managers to make the best decisions. Attention was paid to the stated customer concerns that current transfer pricing methods incorporate overhead and sunk costs that are not attributable to routine movement of peacetime cargo and could make AMC non-price competitive with commercial vendors.

The findings are that AMC currently uses full cost transfer pricing as required by DoD policy that does include significant overhead and sunk costs associated with its wartime responsibilities. The full cost method of transfer pricing is not in congruence with the generally accepted accounting practices and the private sector position that, with excess capacity and no outside market, a unit should transfer price at variable cost (Rayburn, 1986:977).

The current cost of \$6337 per flying hour is inflated by fixed costs, primarily overhead and sunk cost, by 60.47 percent. The corrected figure using variable costing techniques is \$2,505.02. This means that the CPFH is 2.5

times greater than the cost that AMC incurs for operating a peacetime mission.

Unfortunately, due to the mixture of market based transfer pricing and full cost based transfer pricing currently used, as well as SAAM discount effects, it is impossible to determine the extent of the overcharges. However, even for the simple example in chapter four of the channel mission done commercially verse organic airlift, the cost implications are tremendous. Faced with a decision of organic at full cost transfer price, commercial carrier at government rate, or variable cost transfer price, the customer's decision would have been completely altered by the introduction of the variable cost option. On the hypothetical route the customer's cost dropped by over \$15,000 and changed the winning price from the commercial vendor to AMC's organic fleet. This cost reduction is particularly of concern as some routes are using market based transfer prices which are capped at the commercial rate based upon the full cost transfer price. The end result is a decision based upon price that is not in the unit's best interest.

The Death Spiral Revisited

By the mandated full cost recovery method, AMC faces a very serious risk of ending up in a financial "death spiral"

if outsourcing of airlift continues. As the AMC market slowly erodes from programs like World Wide Express, the full cost recovery rates could inflate prices to levels beyond which customers would want to seek service from AMC. The driving force is the unavoidable costs for personnel and infrastructure maintained by DoD to handle wartime responsibilities that when spread over fewer flying hour drives up the full cost transfer price. The AMC costs per flying hour will rise, and the DoD customers are likely seek outside solutions as they are already expressing price concerns at current price levels (Butler 1996;8-9). At an extreme, customers would only use AMC services to move those items that a commercial carrier could not handle. Such items might include hazardous materials, extremely large or heavy sized items, and explosives.

Additionally, unless AMC undergoes mission or overhead reductions to reduce costs in direct proportions to the costs associated with the outsourcing, the Air Force is paying twice. The Air Force will still be paying for the organic fleets missions and overhead while also paying for commercial services. Without such reduction, the customers decision to use commercial over AMC based upon the inflated full cost transfer price forces customers to suboptimize in favor of conserving their own unit's budget dollars at the expense of the total Air Force budget.

The Long Range Perspective

Should an extreme organic airlift cost figure develop, it might draw some commercial interest in under bidding AMC for hauling even the unusual loads. This could greatly erode the last remaining AMC peacetime missions and would leave AMC with only one primary task: serving the movement of armored and paratrooper divisions of the Army and Marine Corps. From a long-range perspective, if AMC's key mission in the future is hauling odd sized cargo much of which is armor, helicopters, paratroopers, and patriot missile batteries that primarily belong to the Army, Army takeover of AMC assets would be a logical step to give unity of command to the key customer.

The other potential future should the AMC peacetime role be significantly reduced is total outsourcing. Should AMC lose enough business, particularly if the unusual and difficult to handle cargo is taken over by the commercial sector, it may be extremely difficult to justify further continuance of an organic fleet. As noted in the introduction, DoD already plans on having 40 percent of its cargo movement during a major contingency come from the Civil Reserve Air Fleet. If AMC no longer has a justifiably unique role or a significantly reduced one, politically

there will be little or no reason to expend funds maintaining a unique and highly expensive organic fleet.

Goal Accomplishment

The other major point to consider in this variable cost issue is the overall effect on goal accomplishment. Remember the purpose of the revolving fund is to focus management attention on the total cost of doing business (Bowsher 1994:11). Literature says that "Ideally, the chosen method should lead each subunit manager to make optimal decisions for the organization as a whole" (Horngren et al., 1994:864). As shown before, there is a clear possibility that a manager may not make the correct decision for organic fleet usage when costs are based upon full cost transfer pricing. However, this decision is a minor problem compared to the overall issue of cost control. Managers must be aware of a cost and have authority to enact changes to the cost in order to control it. Full cost transfer pricing currently is composed of 60.47 percent overhead that is incurred at the AMC bases, headquarters operations, depots, and USTRANSCOM that the customer has no control over.

For example, if the Navy unit at Chana needs C-141 airlift, but gets a budget cut of 15 percent for airlift, it will use less airlift. This budget cutting logic has two

major problems associated with it. First, the cost of the airlift service is not reduced. Variable costs will be incurred if the plane flies; therefore, the only way to actually reduce airlift costs and accomplish the same level of operations is by cutting overhead. Under the current system, organizations that use full cost transfer pricing pass on overhead costs to customers who have no control over this segment of the costs. If the Navy was funded for the variable cost of missions and the airlift squadron, depot, and headquarters operations were given budgets to cover their overhead, a real reduction in costs of overhead could occur. DoD would only have to direct a cut in overhead allocation to AMC or any other organization developing transfer prices.

The second problem is that a cut to the customer will actually drive up the full cost transfer price and is exactly equivalent to the "death spiral" previously associated with the outsourcing situation. The only difference is that hours are cut due to lack of customers having funds not outside competition. However, note that the outside competition could aggravate the problem. As the full cost transfer price rises and the outside competition prices become more attractive for the customer, even fewer AMC hours would be requested.

When to Go Commercial

While the cost figures at variable cost transfer price indicate AMC may be far more competitive than previously believed by customer, this competitiveness in no way implies there is not a place for commercial airlift services. If commercial airlift services are used, the variable cost price for the AMC aircraft should serve as the maximum rate for contracting out air services. Simply put, below variable cost rate the commercial carriers are cheaper to use than AMC's fleet. Otherwise, AMC assets can do the job at the least cost to the customer. Additionally, due to the potentially explosive effect of dropping cargo movement requirements below training hours, up to a seven fold price increase, DoD should never allow cargo movement requirements for AMC to dip below this level while continuing transfer pricing practices.

Future Work

Recommended future research in this area should include a review of all the AMC airframes for validation of their variable costs. Each airframe's costs could then be used as a comparison to existing government contracts to establish the opportunity costs of using commercial services that exceed AMC's variable cost transfer price. The depreciation

issue should be highly scrutinized for establishment of what cost is actually being covered by the depreciation dollars recovered. Cost associated with Supplies/Equipment should be extensively evaluated to determine if there is any applicability to variable pricing of the non-included EEIC's cost elements. Finally, the "death spiral" effect should be explored in depth for the AMC situation considering both losses of business to budget reductions and to impending outsourcing initiatives.

Appendix A: List of Acronyms and Abbreviations

AFLMA	Air Force Logistics Management Agency
AMC	Air Mobility Command
CPFH	Cost Per Flying Hour
DBOF	Defense Business Operating Fund
DLR	Depot Level Repairable
DoD	Department of Defense
DTIC	Defense Technical Information Center
EEIC	Expense Element Identification Code
JCS	Joint Chiefs of Staff
MRS/BURU	Mobility Requirements/Bottoms Up Review
SAAM	Special Assignment Airlift Mission
SAFMA	Strategic Airlift Force Mix Analysis
SMBA	Supply Management Business Area

Bibliography

Arnstein, William E. and Frank Gilabert. Direct Costing. New York: AMACOM, 1980.

Basso, Dalila and Zena Thomas. "Unit Cost Symposium: A Synopsis." Armed Forces Comptroller. Spring 1991:14-16.

Bonasser, Ulissis O. Estimating KC-137 Aircraft Ownership Costs in the Brazilian Air Force. MS thesis, AFIT/GLM/LAS/97J-1. School of Logistics and Acquisition Management, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, June 1997.

Bond, David F. "C-141Bs Fly Middle East Missions Despite Weight, Operations Curbs." Aviation Week & Space Technology. 133:21 (August 7, 1990).

Bowsher, Charles A. "Financial Management Financial Control and System Weaknesses Continue to Waste DoD Resources and Undermine Operations." Report Series T-AIMD/NSIAD-94; No. 154. Washington: Government Printing Office, 1994.

Butler, Tom. "Air Cargo Movement." Address to DUSD(L), 31 July 1996.

Cambell, Sharon and Kurt Woller. HQ AFMC/FMRI Interview. 14 July 1997.

Camm, Frank and H. L. Shulman. When Internal Transfer Prices and Costs Differ: How Stock Funding of Depot Level Repairables Affects Decision Making in the Air Force. Report Series MR-397-AF. RAND: Santa Monica, 1993.

Cashin, James A. Cost Accounting. New York: McGraw-Hill, Inc., 1981.

Closing Maintenance Depots Savings, Workload, and Redistribution Issues. Report Series NSIAD-96; No. 29. Washington: Government Printing Office, 1996.

Conahan, Frank C. Defense Programs and Spending Need for Reforms. Report Series T-NSIAD-95; No. 149. Washington: Government Printing Office, 1995.

Cunningham, William A. Class handout, LOGM 617,
Transportation Systems. School of Logistics and
Acquisition Management, Air Force Institute of
Technology, Wright-Patterson AFB OH, January 1997.

"Fact Sheet C-141B Starlifter." WWWeb,
<http://www.safb.af.mil/.../pa/units/amcfa...> (24
October 1996).

Fulghum, David A. "USAF Chief Favors C-17s As C141s Retire
Early." Aviation Week & Space Technology. 141:20
(December 1994).

Gebicke, Mark E. Strategic Airlift Further Effort Can Be
Taken to Extend Aircraft Service Life. Report Series
NSIAD-94; No. 222. Washington: Government Printing
Office, 1994.

Gebman, Jean R. and others. Finding the Right Mix of
Military and Civil Airlift, Issues and Implications.
Vol. I-III. RAND: Santa Monica, 1994.

Hinton, Henry L. Defense Transportation: Streamlining of the
U.S. Transportation Command is Needed. Report Series
NSIAD-96; No. 60. Washington: Government Printing
Office, 1996.

Horngren, Charles T. Cost Accounting: A Managerial Emphasis
(Eighth Edition). New Jersey: Prentice Hall, 1994.

Hough, Paul G. "Are All Costs Variable (Or How to Handle
Fixed Costs)." Armed Forces Comptroller. Winter 1993:
14-20.

Jane's All the World's Aircraft. New York: McGraw-Hill,
1964.

Killingsworth, Paul and others. Guard and Reserve
Participation in the Air Mobility System. RAND: Santa
Monica, 1993.

Kingsbury, Nancy R. and David Connor, Financial Systems:
Weaknesses Impede Initiatives to Reduce Air Force
Operations and Support Costs. Report Series NSIAD-93;
No. 70. Washington: Government Printing Office, 1993.

LaCivita, Charles J. and Robert L. Pirog, "Using Unit Costs to Promote Effective Management." Armed Forces Comptroller. Winter 1991. Washington: Government Printing Office, 1991.

Lambert, Douglas M. and James R. Stock. Strategic Logistics Management (Third Edition). Chicago: Richard D. Irwin, 1993.

Larsen, Patricia M. A Study of the Air Force Depot Maintenance Cost Allocation for Cost Factor Development. MS thesis, AFIT/GSM/LSM/86S-13. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, September 1986 (AD-A174443).

Lewis, Theresa A. A Comparison of AMC Cargo Channel Flights and Alternative Commercial Freight Carriers. MS Thesis. Naval Post Graduate School, Monterey CA, March 1995 (ADA295116).

Managerial Cost Accounting Concepts and Standards for the Federal Government, Statement of Federal Financial Accounting Standards Number 4. U.S. Government Printing Office. Washington DC, 1995.

Nelleman, David O. Defense Business Operating Fund Improved Pricing Practices and Financial Reports Are Needed to Set Accurate Prices. Report series AIMD-94;No.132. Washington: Government Printing Office, 1994.

Nettemeyer, Michael A. Chief TWCF Flight, AMC Financial Services Squadron. Personal Correspondence. 31 Jan 1997.

Neuner, John J.W. and Edward B. Deakin III. Cost Accounting Principles and Practice. Chicago: Richard D. Irwin, 1977.

O'Mara, Robert G. US Government Airlift Rates and Non-US Government Airlift Rates. Headquarters Air Mobility Command: 11 August 1995.

O'Mara, Robert G. Budget Division, Directorate of Comptroller. Personal Correspondence. 27 September 1996.

O'Mara, Robert G. Budget Division, Directorate of Comptroller. Personal Correspondence. 19 November 1996.

Palmer, Adele R. A. and others. Assessing the Structure and Mix of Future Active and Reserve Forces: Cost Estimating Methodology. Santa Monica: RAND 1992.

Posner, Paul L. Budget Issues the Role of Depreciation in Budgeting for Certain Federal Investments. Report Series AIMD-95; No. 34. Washington: Government Printing Office, 1995.

Rayburn, Letricia G. Principles of Cost Accounting: Managerial Applications (Third Edition). Illinois: Irwin, 1986.

Sabo, Cindy. HQ AMC/DON. Telephone interview. 24 May 1997.

Schloz, Lois J. and David W. Jones. Aircraft Depot Level Repairable Cost Per Flying Hour Lessons Learned. Report Series LM931581; Air Force Logistics Management Agency, Gunter AFB, 1994.

Skousen, K. Fred and others. Accounting Concepts and Applications (Fifth Edition). Cincinnati: South-Western Publishing, 1996.

Tirpak, John A. "Airlift Moves Up and Out." Air Force Magazine. 79:26-32 (February 1996).

Unit Cost. Washington: Government Printing Office, 1994.

Vaughn, Robin F. Analysis of the Air Force Cost Analysis Improvement Group Cost Per Flying Hour Process. AFLMA Project Number: LM9629920. September 1993.

Waker, Michael P. A Model for Estimating Depot Maintenance Costs for Air Force Fighter and Attack Aircraft. MS thesis, AFIT/GSM/LSQ/87S-36. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, September 1987 (AD-A187097).

Wallace, John T. A Critical Analysis of the Use of Cost Per Flying Hour Factors to Adjust the USAF POM Requirements for Replenishment Spares. Report Number 84-2695. Air Command and Staff College, Air University, Maxwell AFB AL, 24 July 1984.

Zimmerman, Jerold L. Accounting for Decision Making and Control. New York: McGraw-Hill, 1997.

Vita

Capt Christopher J. Omior [REDACTED]

[REDACTED] Graduated from Vandalia-Butler High School in 1983 and entered undergraduate studies at the University of Michigan in Ann Arbor, Michigan. He graduated with a Bachelors of Science and Engineering in Material and Metallurgical Engineering in December 1987. He received his commission on 22 December 1987.

His first assignment was at Offutt AFB as a supply officer. He served in this capacity at his second assignment at Iraklion AS Crete Greece. Upon arriving in Ottawa Canada, his duties at the North Warning System made him a government quality assurance representative for monitoring contractor operations at the North Warning Sites. His follow-on tour at Andersen AFB Guam brought a new career as a fuels flight commander. In June of 1996, Capt Omior entered the School of Logistics and Acquisition Management, Air Force Institute of Technology.

[REDACTED]

[REDACTED]

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of the collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)			2. REPORT DATE September 1997		3. REPORT TYPE AND DATES COVERED Master's Thesis	
4. TITLE AND SUBTITLE COST PER FLYING HOUR ANALYSIS OF THE C-141			5. FUNDING NUMBERS			
6. AUTHOR(S) Captain Christopher J. Omlor						
7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S) Air Force Institute of Technology 2950 P Street WPAFB OH 45433-7765			8. PERFORMING ORGANIZATION REPORT NUMBER AFIT/GTM/LAL/97S-7			
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			10. SPONSORING / MONITORING AGENCY REPORT NUMBER			
11. SUPPLEMENTARY NOTES						
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited				12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 Words) This paper sought to examine if DoD's current transfer pricing method places AMC in a price competitive position with the government commercial rates and promotes managers to make the best decisions. Attention was paid to the stated customer concerns that current transfer pricing methods incorporate overhead and sunk costs that are not attributable to routine movement of peacetime cargo and could make AMC non-price competitive with commercial vendors. The findings are that AMC currently uses full cost transfer pricing, as required by DoD policy, that includes significant overhead and sunk costs associated with its wartime responsibilities. The full cost method of transfer pricing is not in congruence with the generally accepted accounting practices and the private sector position that, with excess capacity and no outside market, a unit should transfer price at variable cost. The current cost per flying hour is inflated by fixed costs, primarily overhead and sunk cost, by 60.47 percent. This means the CPFH is 2.5 times greater than the cost that AMC incurs for operating a peacetime mission.						
14. Subject Terms Cost Analysis, C-141, Variable Cost, Unit Cost						15. NUMBER OF PAGES 84
						16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL			

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)

Prescribed by ANSI Std. Z39-18
298-102

AFIT RESEARCH ASSESSMENT

The purpose of this questionnaire is to determine the potential for current and future applications of AFIT thesis research. **Please return completed questionnaire to: AIR FORCE INSTITUTE OF TECHNOLOGY/LAC, 2950 P STREET, WRIGHT-PATTERSON AFB OH 45433-7765.** Your response is important. Thank you.

1. Did this research contribute to a current research project? a. Yes b. No

2. Do you believe this research topic is significant enough that it would have been researched (or contracted) by your organization or another agency if AFIT had not researched it? a. Yes b. No

3. Please estimate what this research would have cost in terms of manpower and dollars if it had been accomplished under contract or if it had been done in-house.

Man Years **\$**

4. Whether or not you were able to establish an equivalent value for this research (in Question 3), what is your estimate of its significance?

a. Highly Significant b. Significant c. Slightly Significant d. Of No Significance

5. Comments (Please feel free to use a separate sheet for more detailed answers and include it with this form):

Name and Grade

Organization

Position or Title

Address